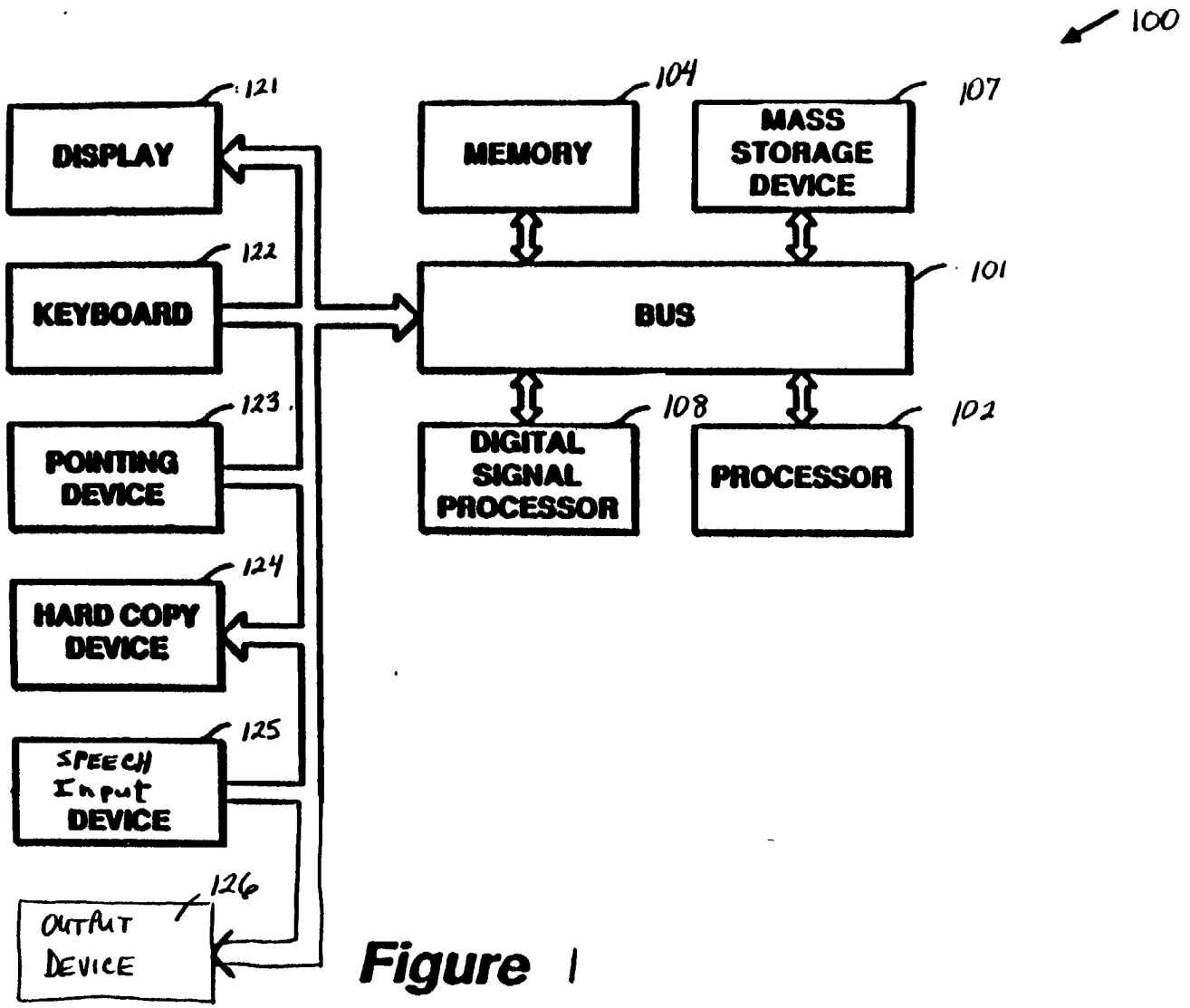

100
121
DISPLAY
104
MEMORY
107
MASS STORAGE DEVICE
122
KEYBOARD
101
BUS
123
POINTING DEVICE
108
DIGITAL SIGNAL PROCESSOR
102
PROCESSOR
124
HARD COPY DEVICE
125
SPEECH Input DEVICE
126
OUTPUT DEVICE

Figure 1

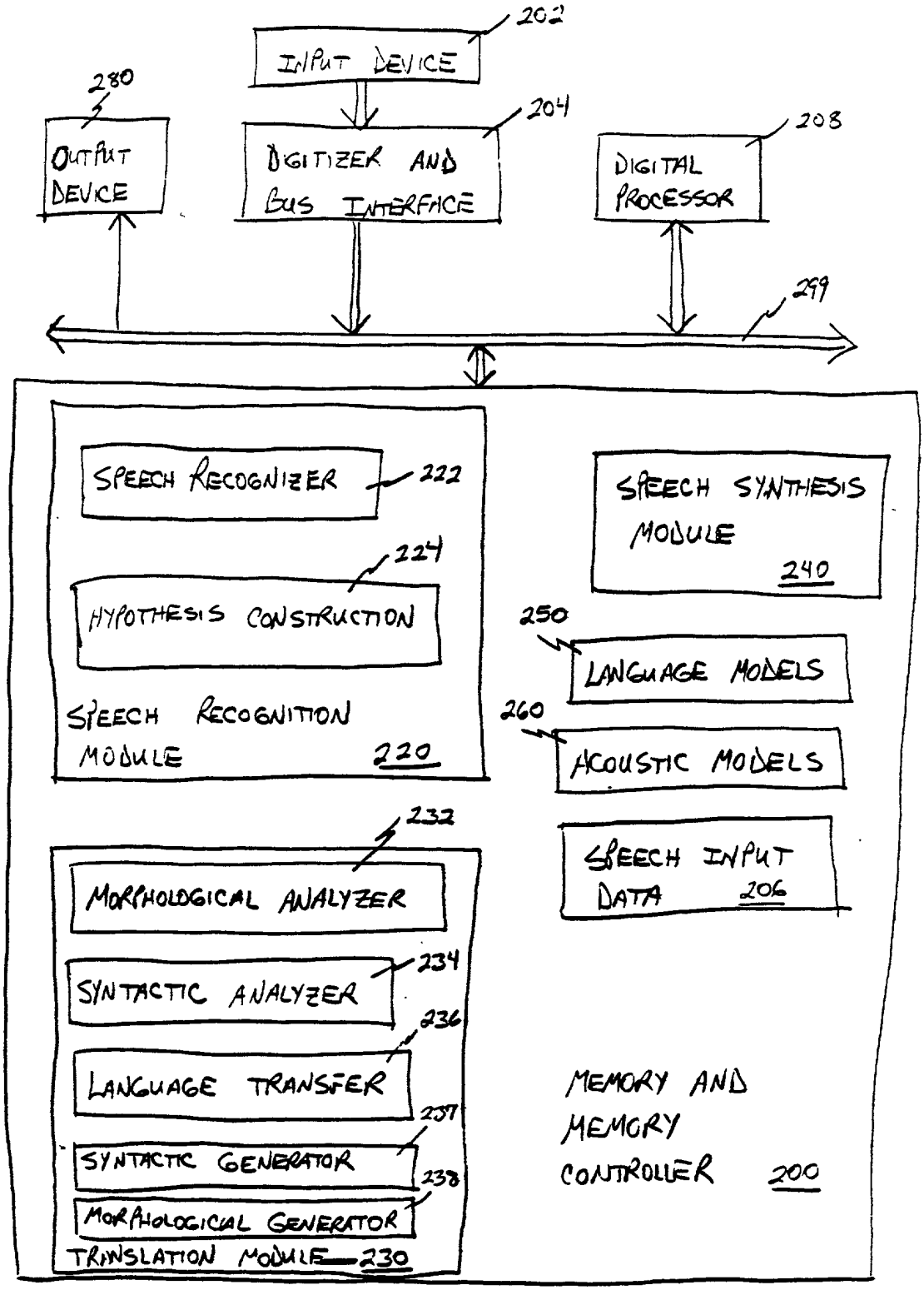

202
INPUT DEVICE
280
OUTPUT DEVICE
204
DIGITIZER AND BUS INTERFACE
208
DIGITAL PROCESSOR
299
SPEECH RECOGNIZER
222
224
HYPOTHESIS CONSTRUCTION
SPEECH RECOGNITION MODULE 220
SPEECH SYNTHESIS MODULE 240
250
LANGUAGE MODELS
260
ACOUSTIC MODELS
SPEECH INPUT DATA 206
232
MORPHOLOGICAL ANALYZER
234
SYNTACTIC ANALYZER
236
LANGUAGE TRANSFER
237
SYNTACTIC GENERATOR
238
MORPHOLOGICAL GENERATOR
TRANSLATION MODULE 230
MEMORY AND MEMORY CONTROLLER 200

FIGURE 2

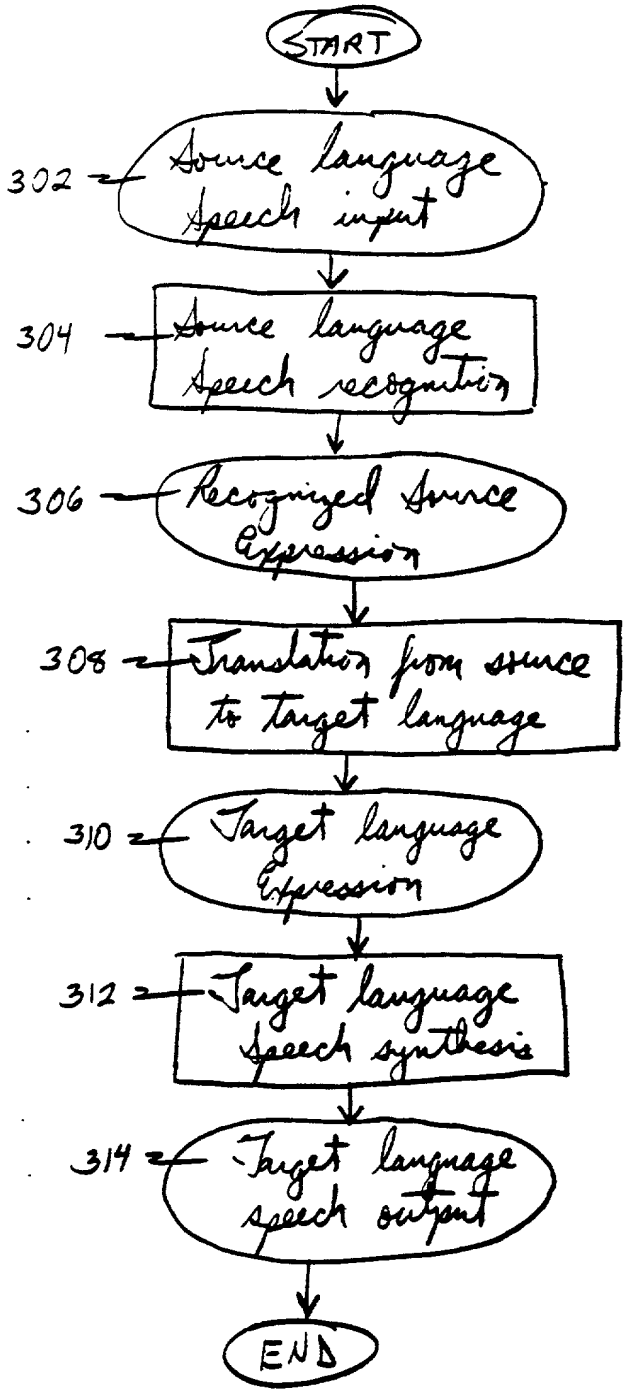

START
302
Source language Speech input
304
Source language Speech recognition
306
Recognized Source Expression
308
Translation from source to target language
310
Target language Expression
312
Target language Speech synthesis
314
Target language speech output
END

FIGURE 3

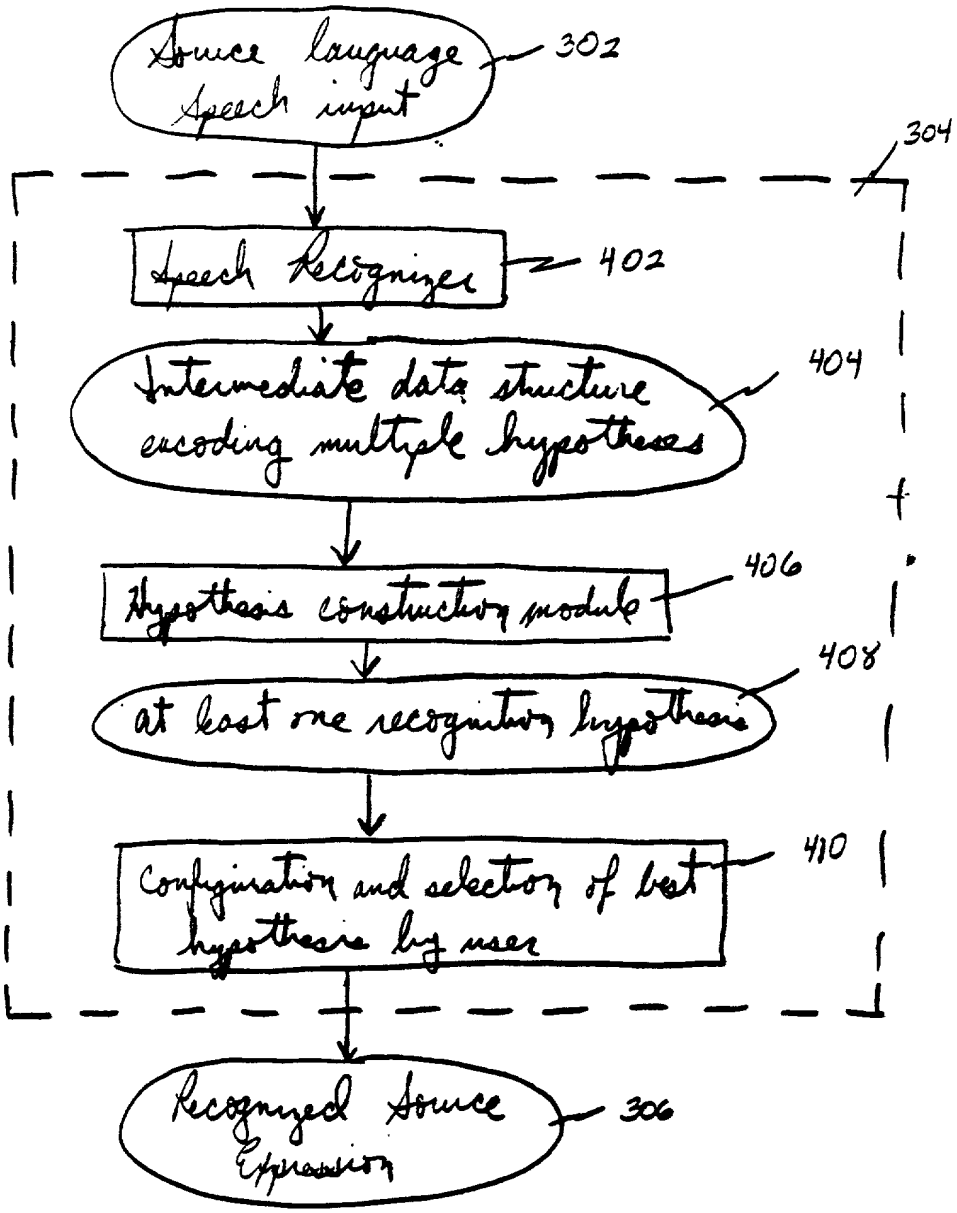



FIGURE 4

0980850-080402

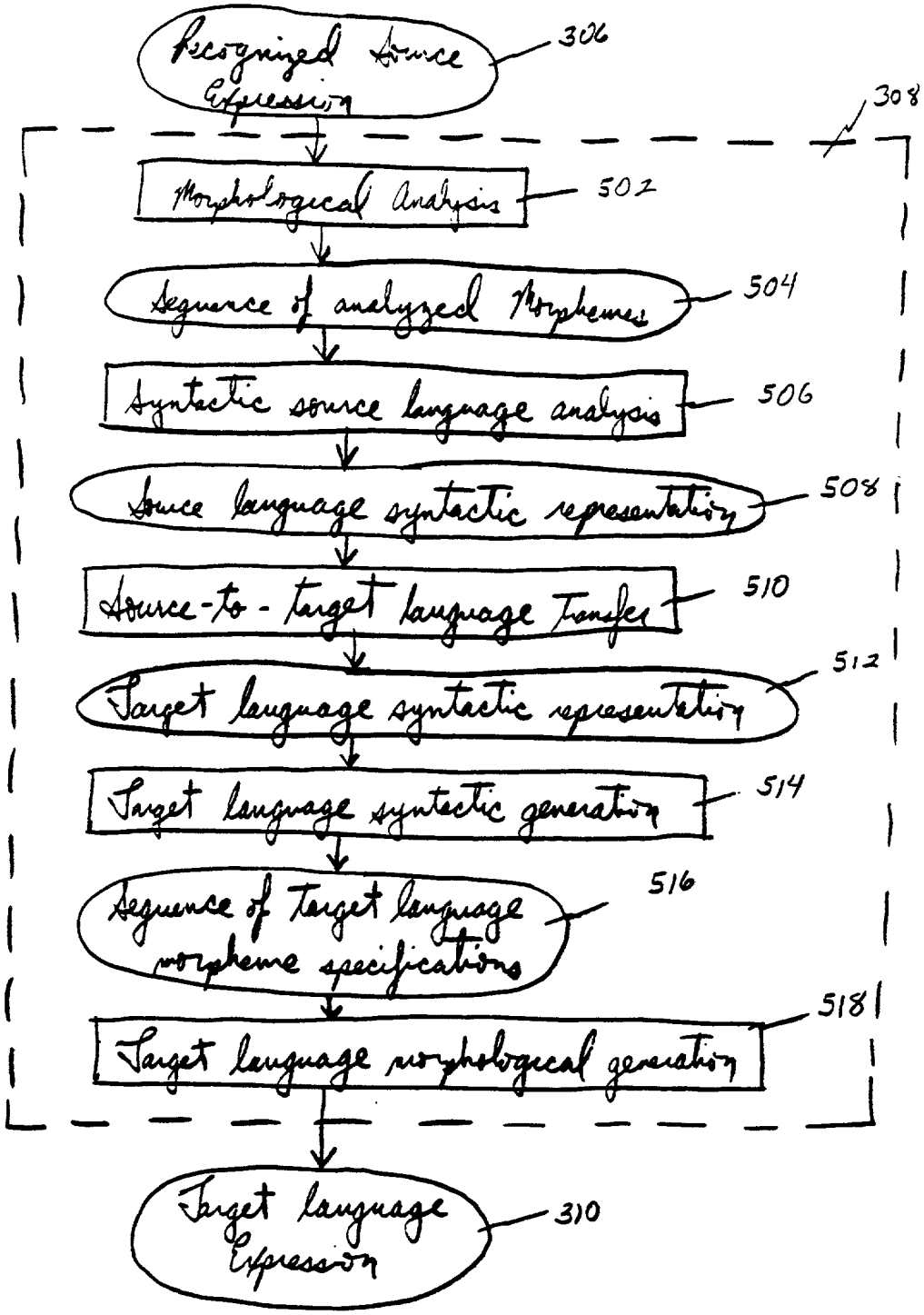
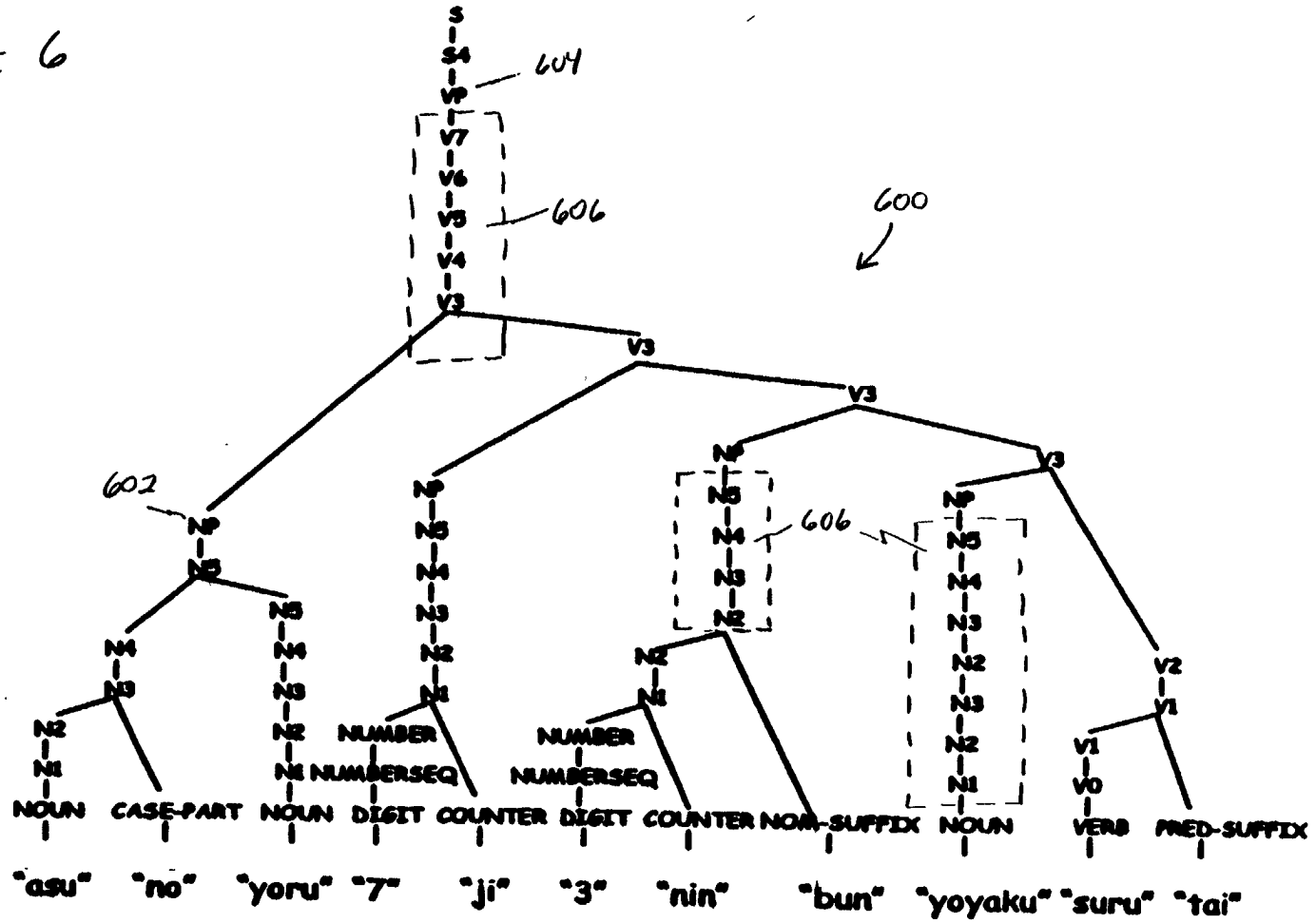

Recognized Source Expression
306
308
Morphological Analysis
502
Sequence of analyzed Morphemes
504
Syntactic source language analysis
506
Source language syntactic representation
508
Source-to-target language Transfer
510
Target language syntactic representation
512
Target language syntactic generation
514
Sequence of Target language morpheme specifications
516
Target language morphological generation
518
Target language Expression
310

FIGURE 5

FIGURE 6



TOETBO" 05898860

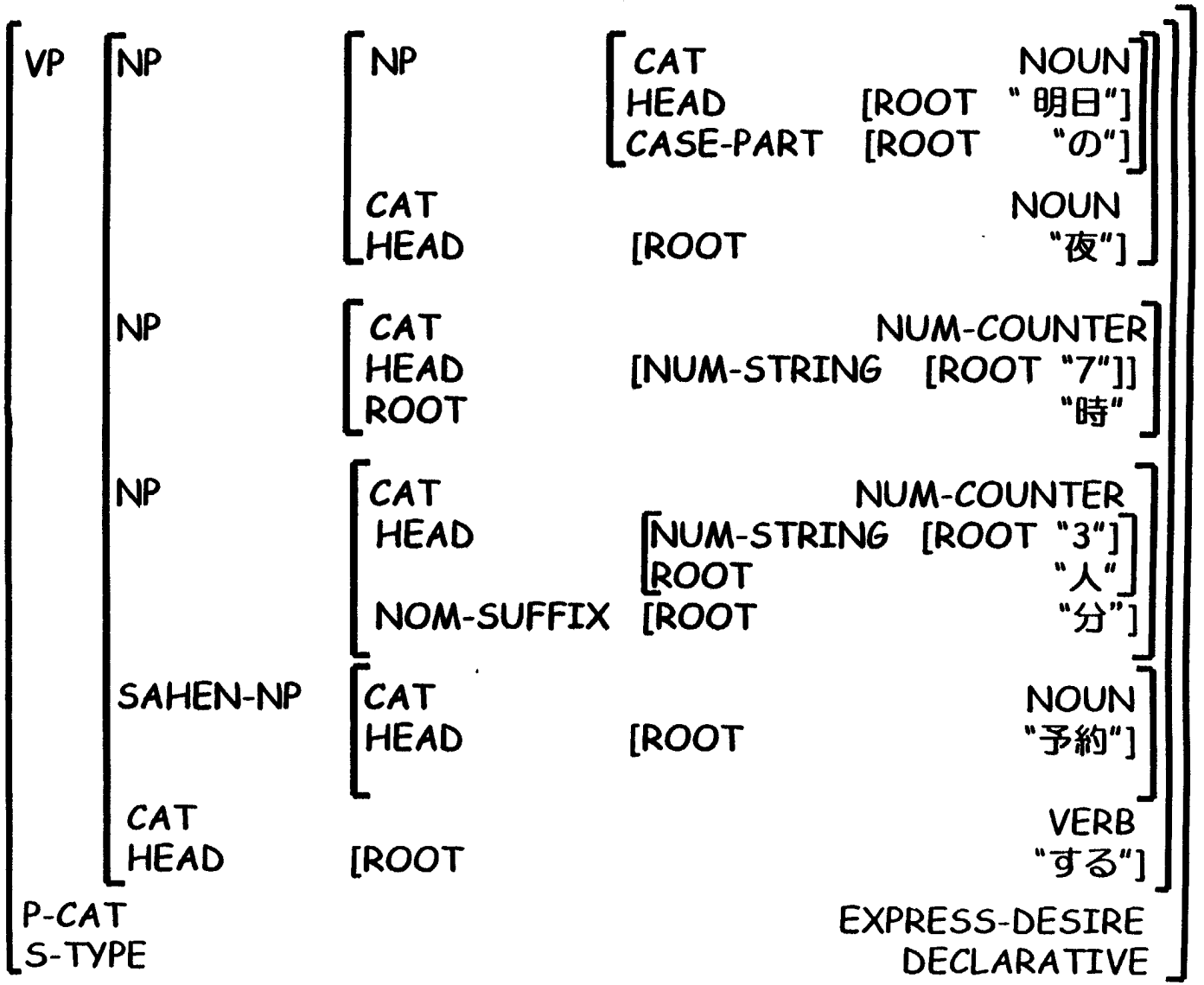



FIGURE 7

TOET80" 05898860

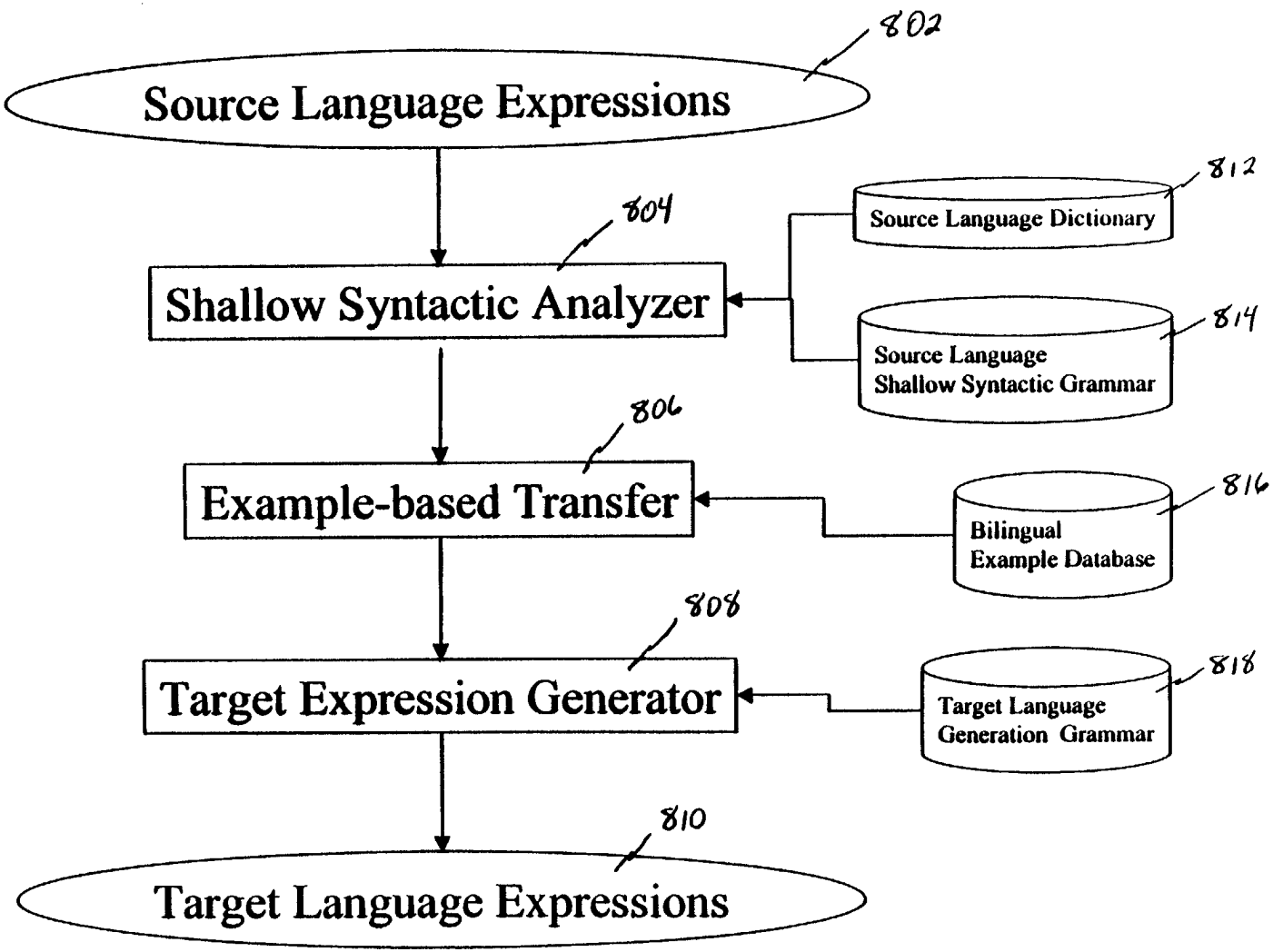



FIGURE 8

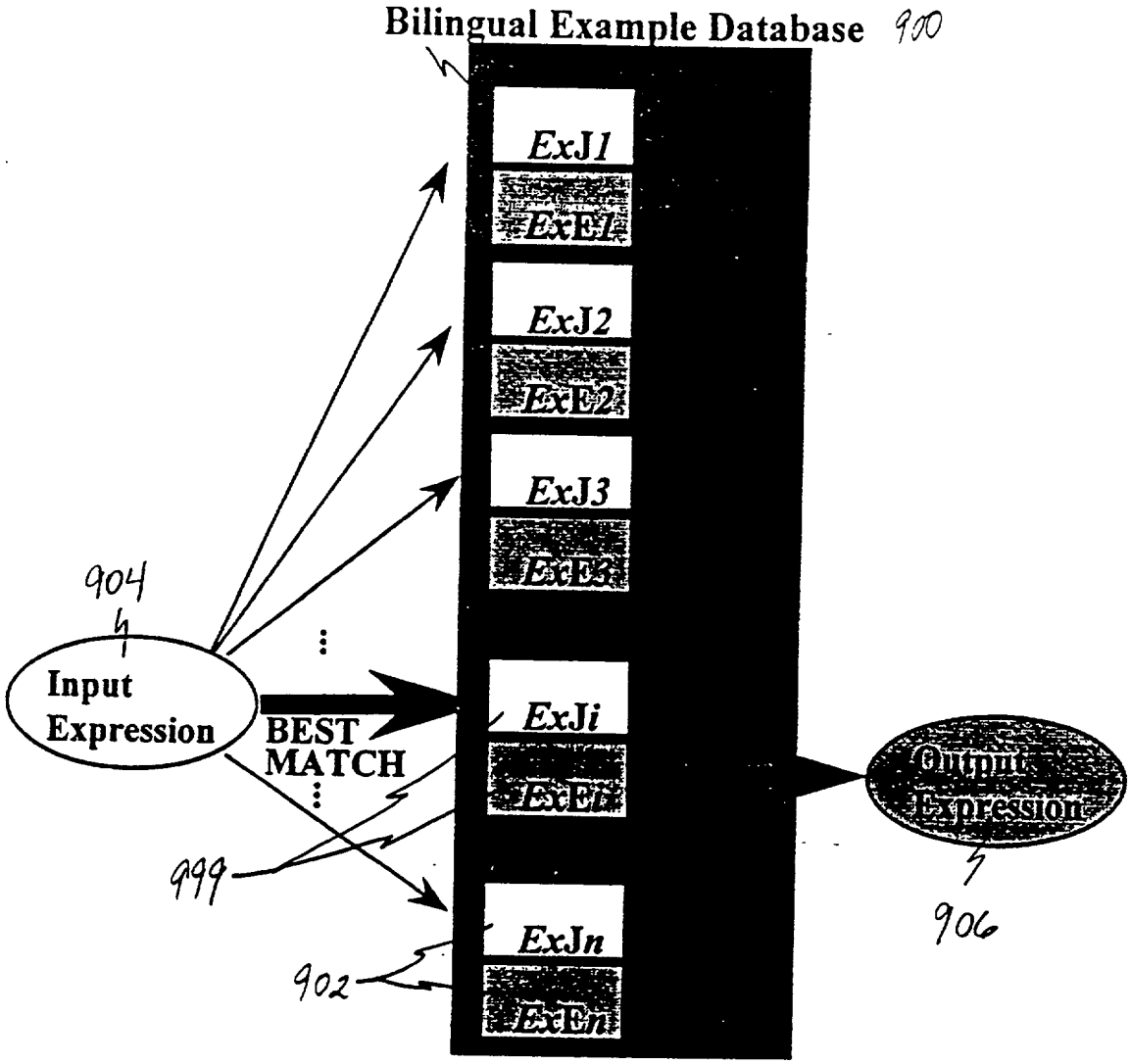

Bilingual Example Database 900
ExJ1
ExE1
ExJ2
ExE2
ExJ3
ExE3
ExJi
ExEi
ExJn
ExEn
904
Input Expression
BEST MATCH
999
902
Output Expression
906

FIGURE 9

TOET80" 05898860

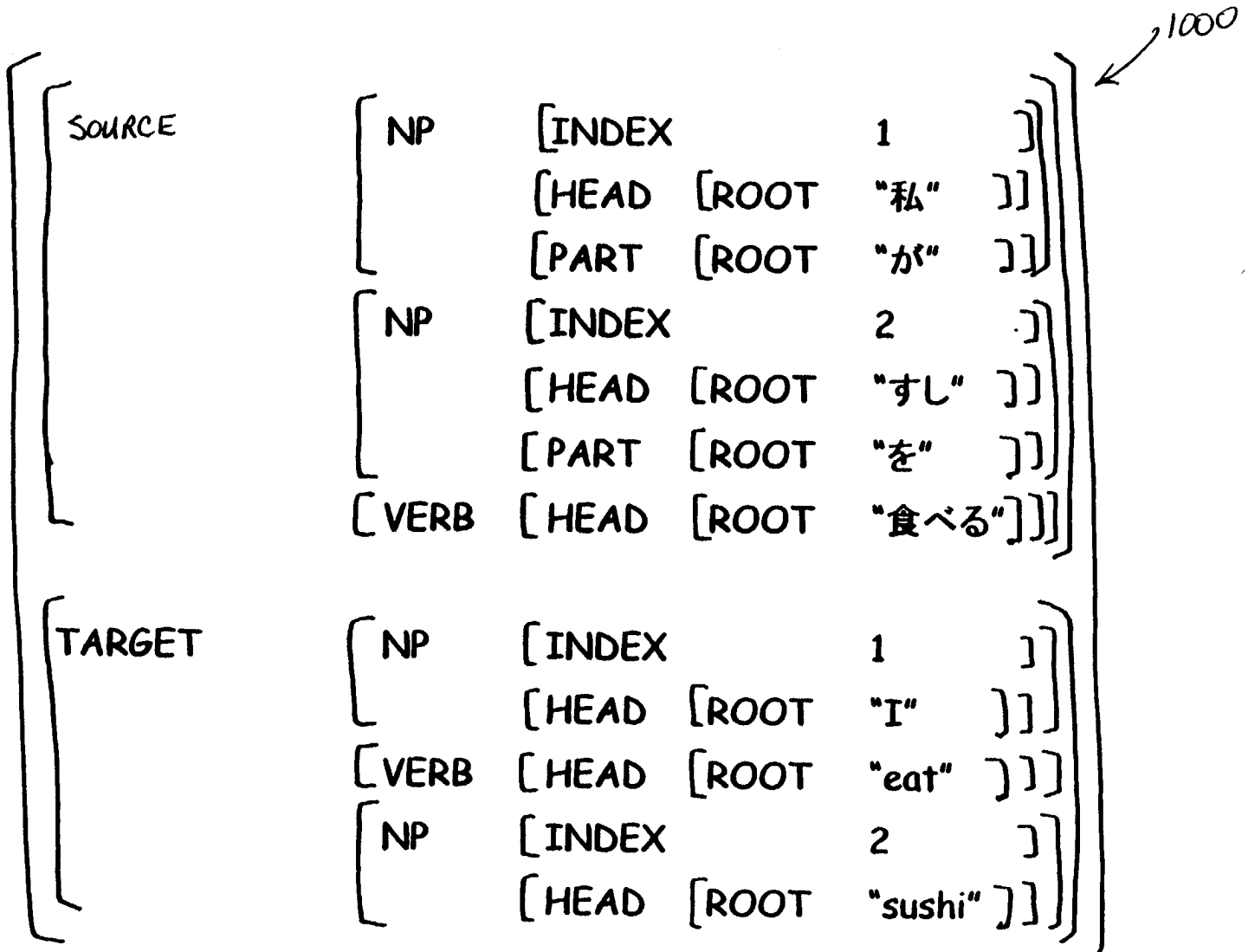



FIGURE 10

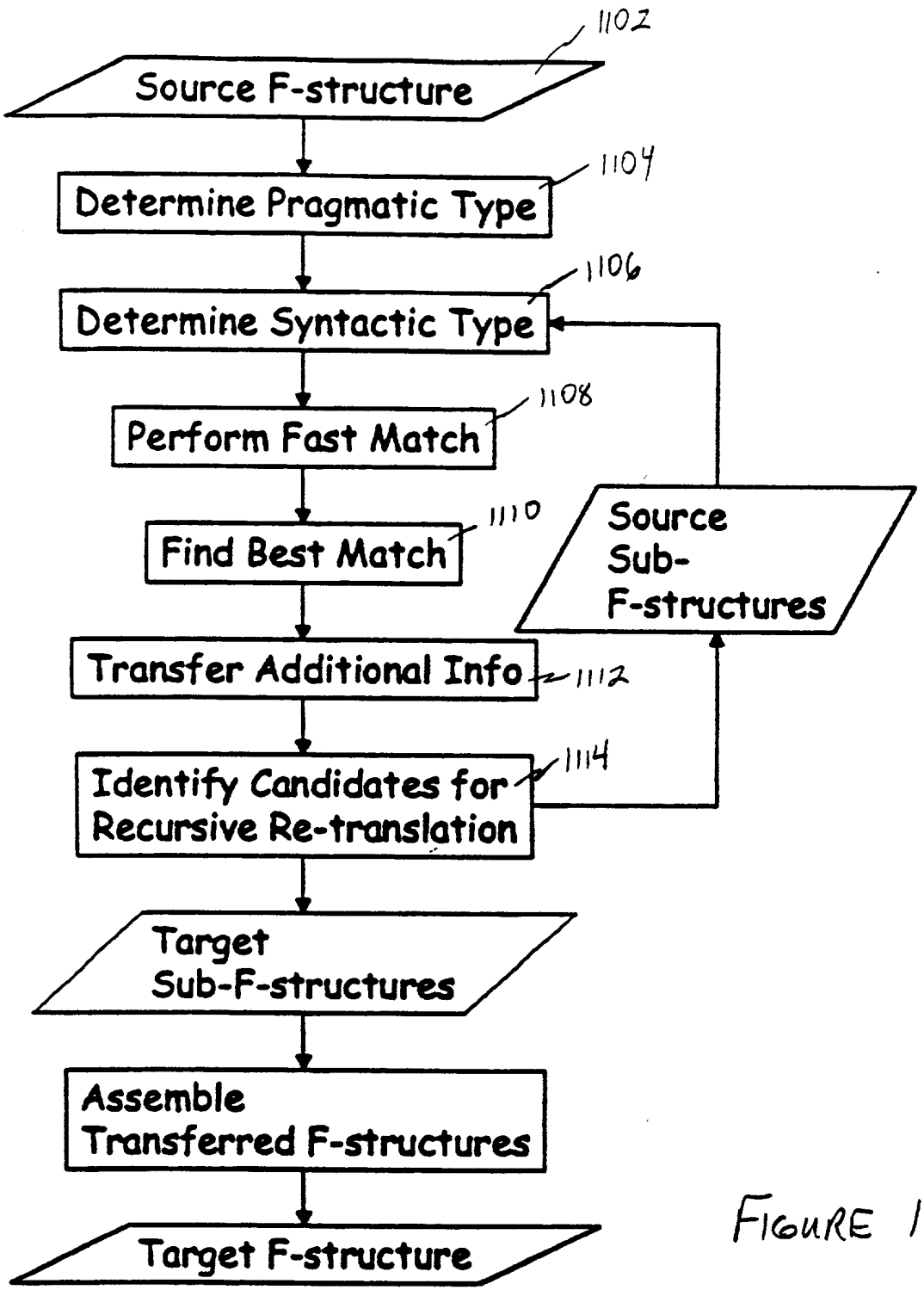

1102
Source F-structure
1104
Determine Pragmatic Type
1106
Determine Syntactic Type
1108
Perform Fast Match
1110
Find Best Match
Source
Sub-
F-structures
Transfer Additional Info
1112
1114
Identify Candidates for
Recursive Re-translation
Target
Sub-F-structures
Assemble
Transferred F-structures
Target F-structure

FIGURE 11

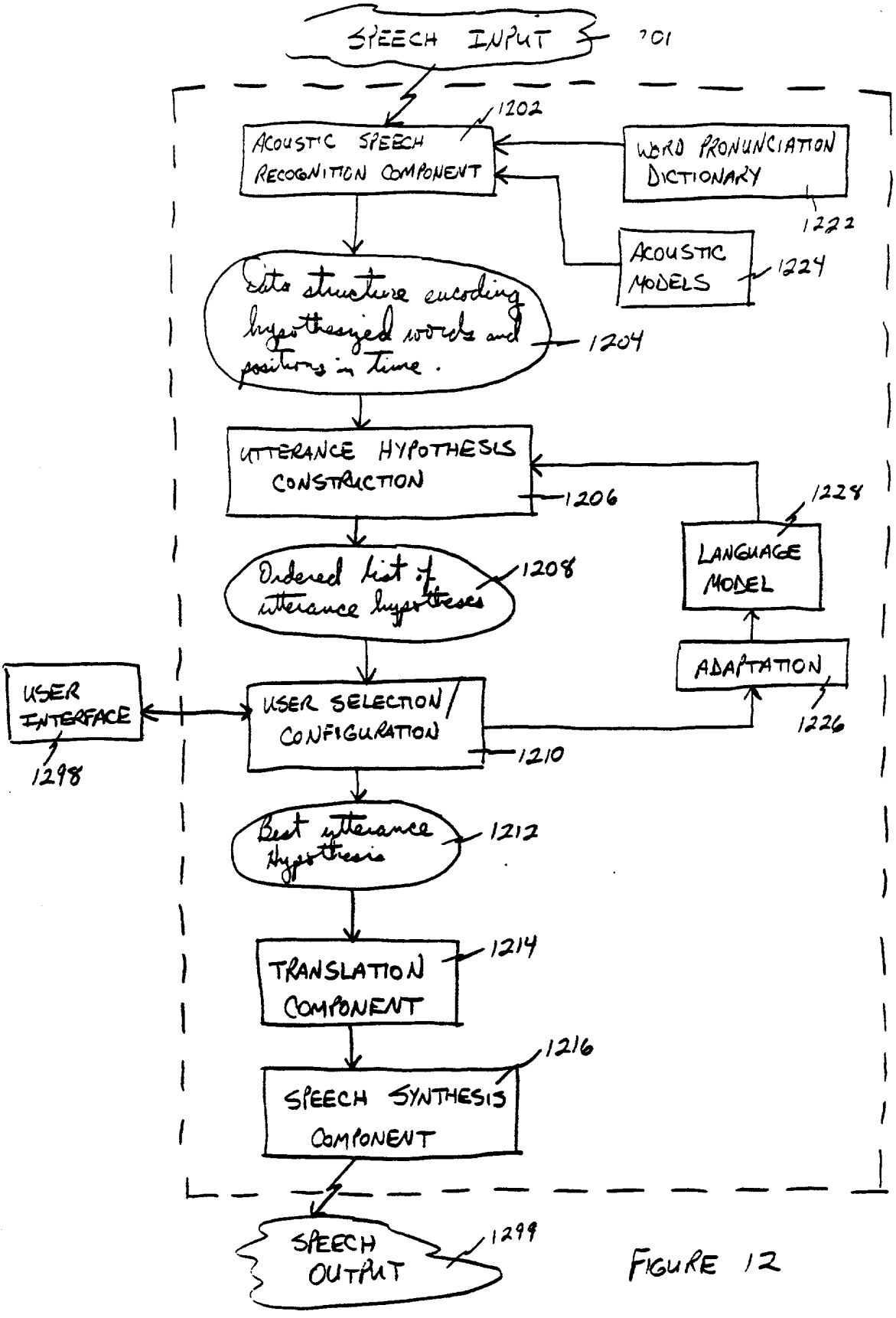
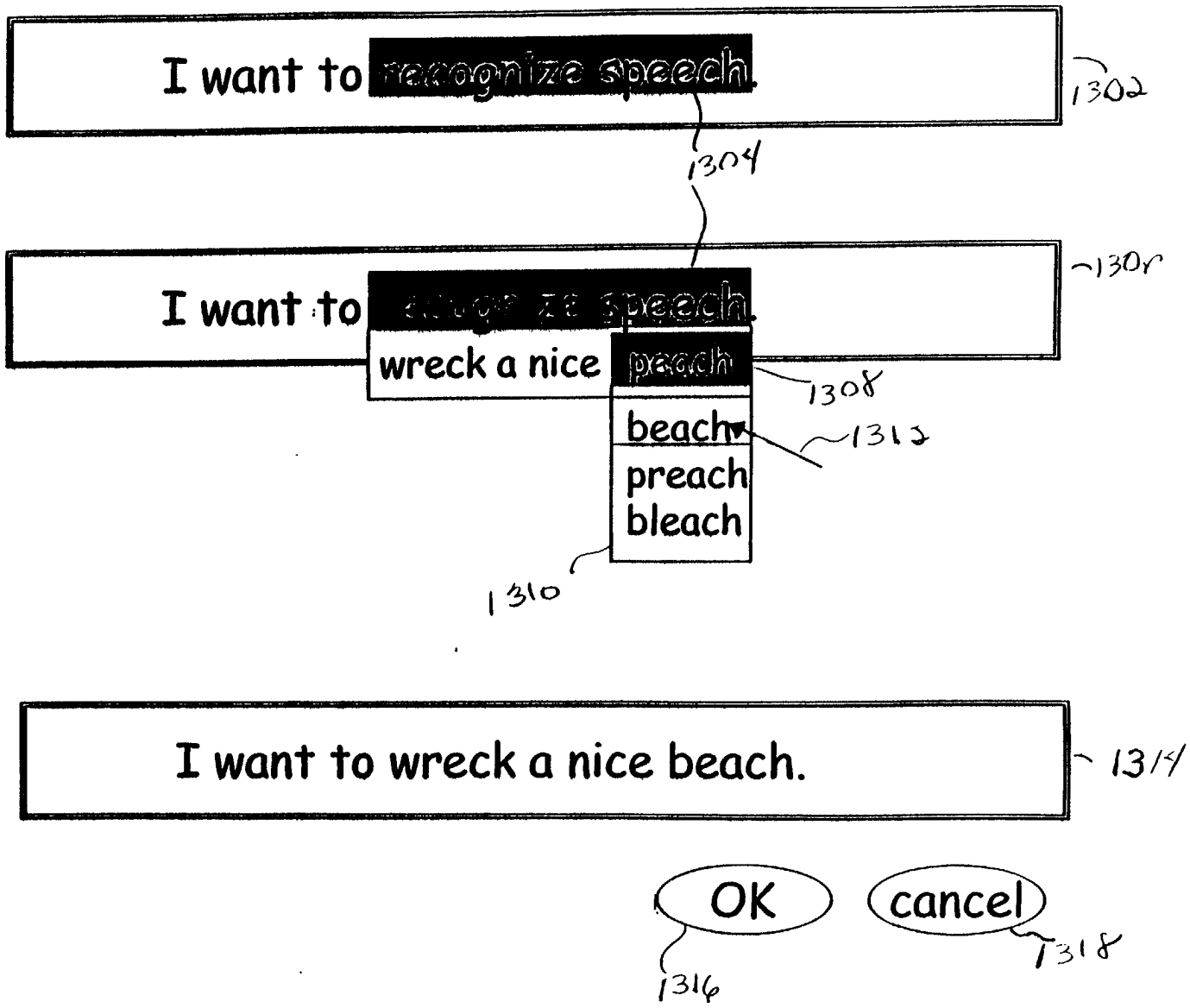

SPEECH INPUT
1201
1202
ACOUSTIC SPEECH RECOGNITION COMPONENT
WORD PRONUNCIATION DICTIONARY
1222
ACOUSTIC MODELS
1224
Data structure encoding hypothesized words and positions in time.
1204
UTTERANCE HYPOTHESIS CONSTRUCTION
1206
1224
LANGUAGE MODEL
Ordered list of utterance hypotheses
1208
ADAPTATION
1226
USER INTERFACE
1298
USER SELECTION / CONFIGURATION
1210
Best utterance hypothesis
1212
TRANSLATION COMPONENT
1214
1216
SPEECH SYNTHESIS COMPONENT
SPEECH OUTPUT
1299

FIGURE 12

TOETBO" 05898860

Figure13



TOET80" 09898860

Figure 14

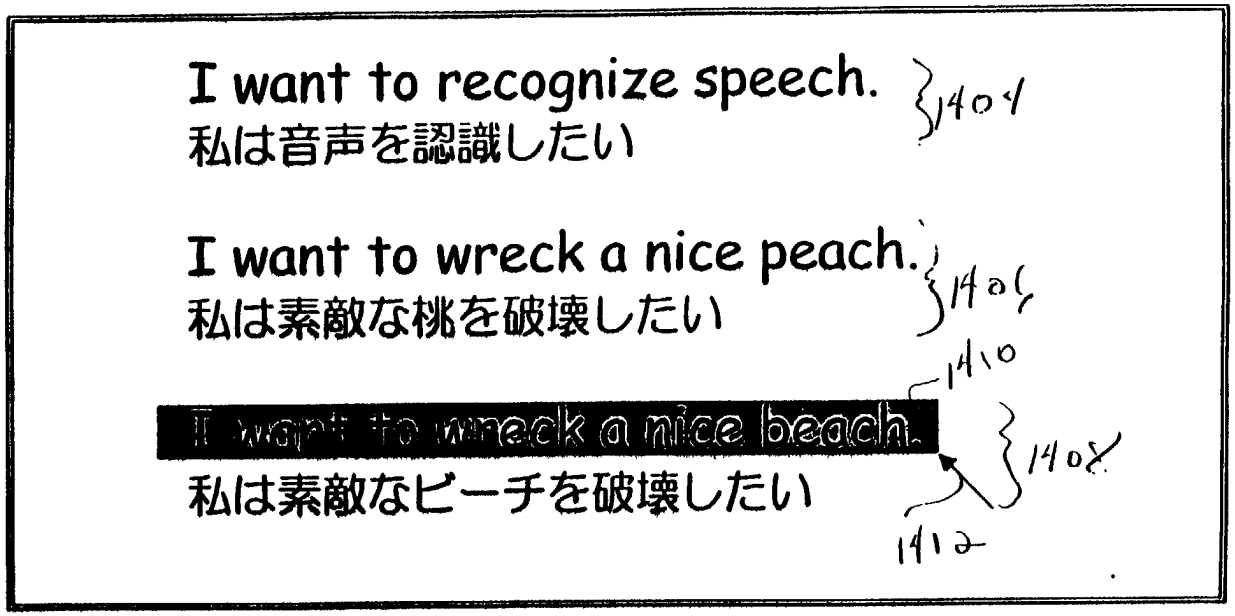


Figure 15

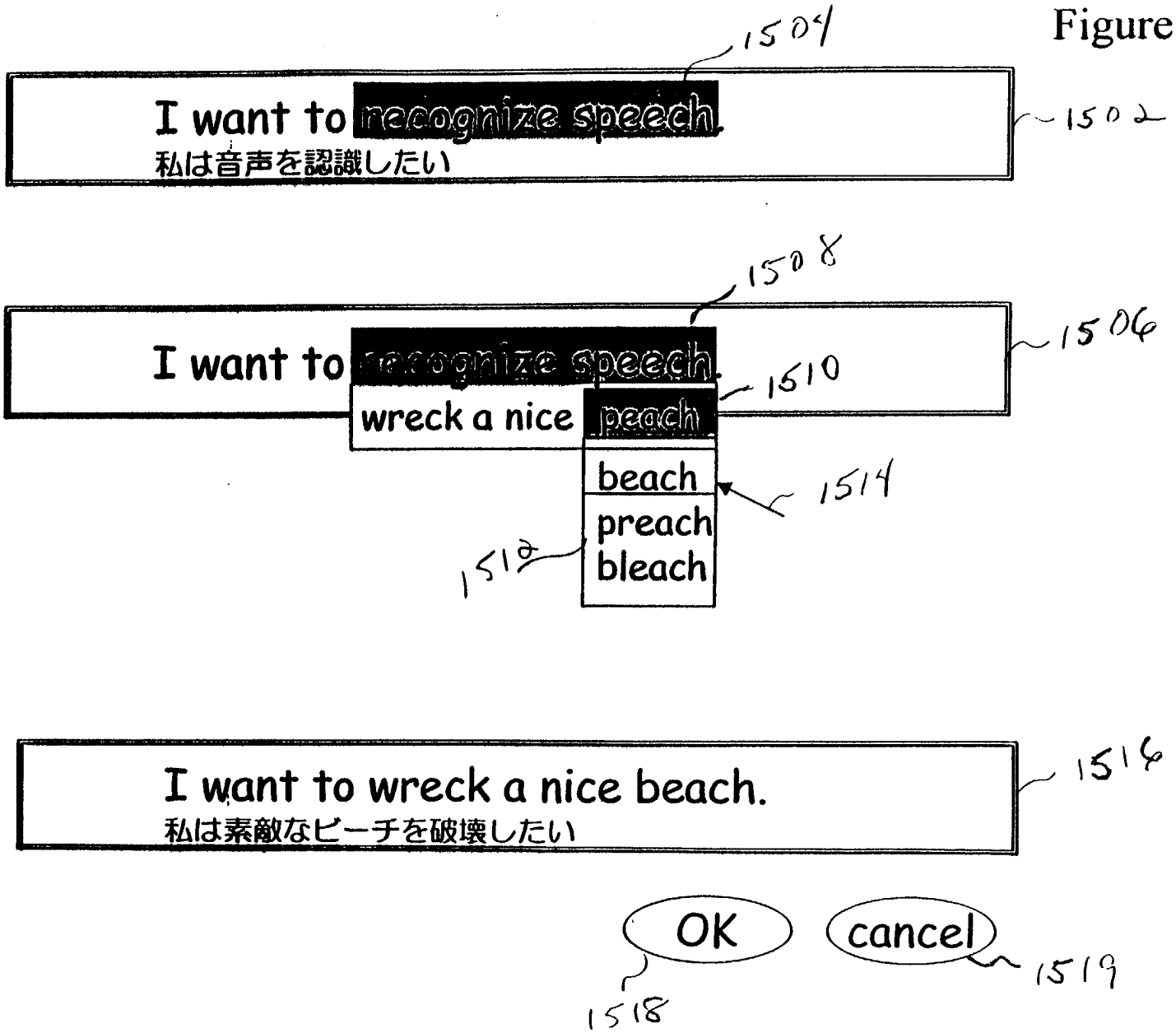
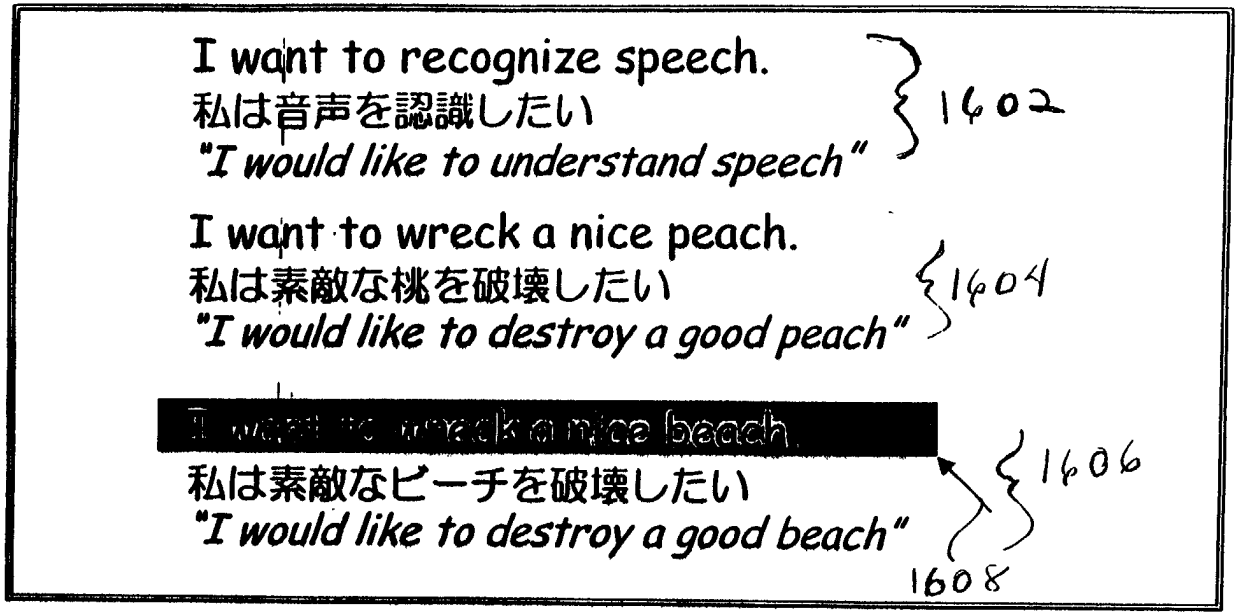
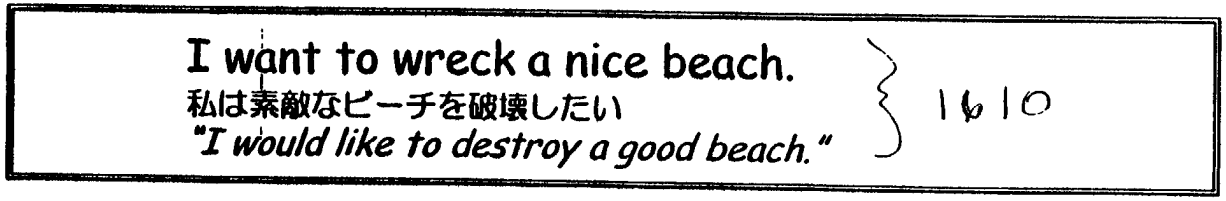

1504
I want to recognize speech
私は音声を認識したい
1502
1508
I want to recognize speech
1510
wreck a nice peach
1506
beach
preach
bleach
1514
1512
I want to wreck a nice beach.
私は素敵なビーチを破壊したい
1516
OK
cancel
1518
1519

Figure 16


I want to recognize speech.
私は音声を認識したい
"I would like to understand speech"
1602
I want to wreck a nice peach.
私は素敵な桃を破壊したい
"I would like to destroy a good peach"
1604
I want to wreck a nice beach.
私は素敵なビーチを破壊したい
"I would like to destroy a good beach"
1606
1608


I want to wreck a nice beach.
私は素敵なビーチを破壊したい
"I would like to destroy a good beach."
1610

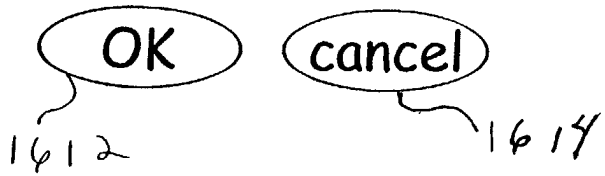
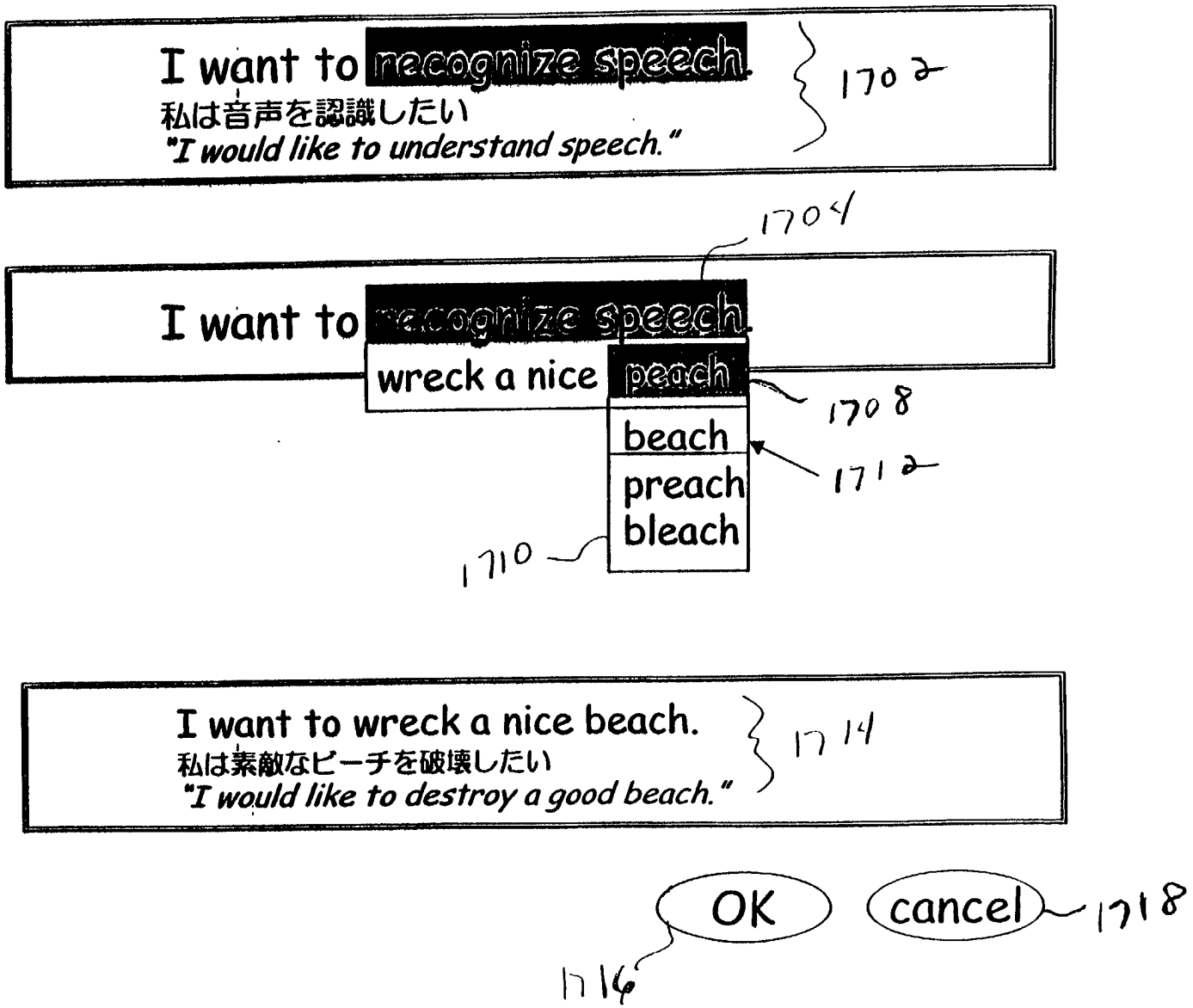

OK
cancel
1612
1614

Figure17


I want to recognize speech
私は音声を認識したい
"I would like to understand speech."
1702
1704
I want to recognize speech
wreck a nice
peach
beach
preach
bleach
1708
1712
1710
I want to wreck a nice beach.
私は素敵なビーチを破壊したい
"I would like to destroy a good beach."
1714
OK
cancel
1718
1716

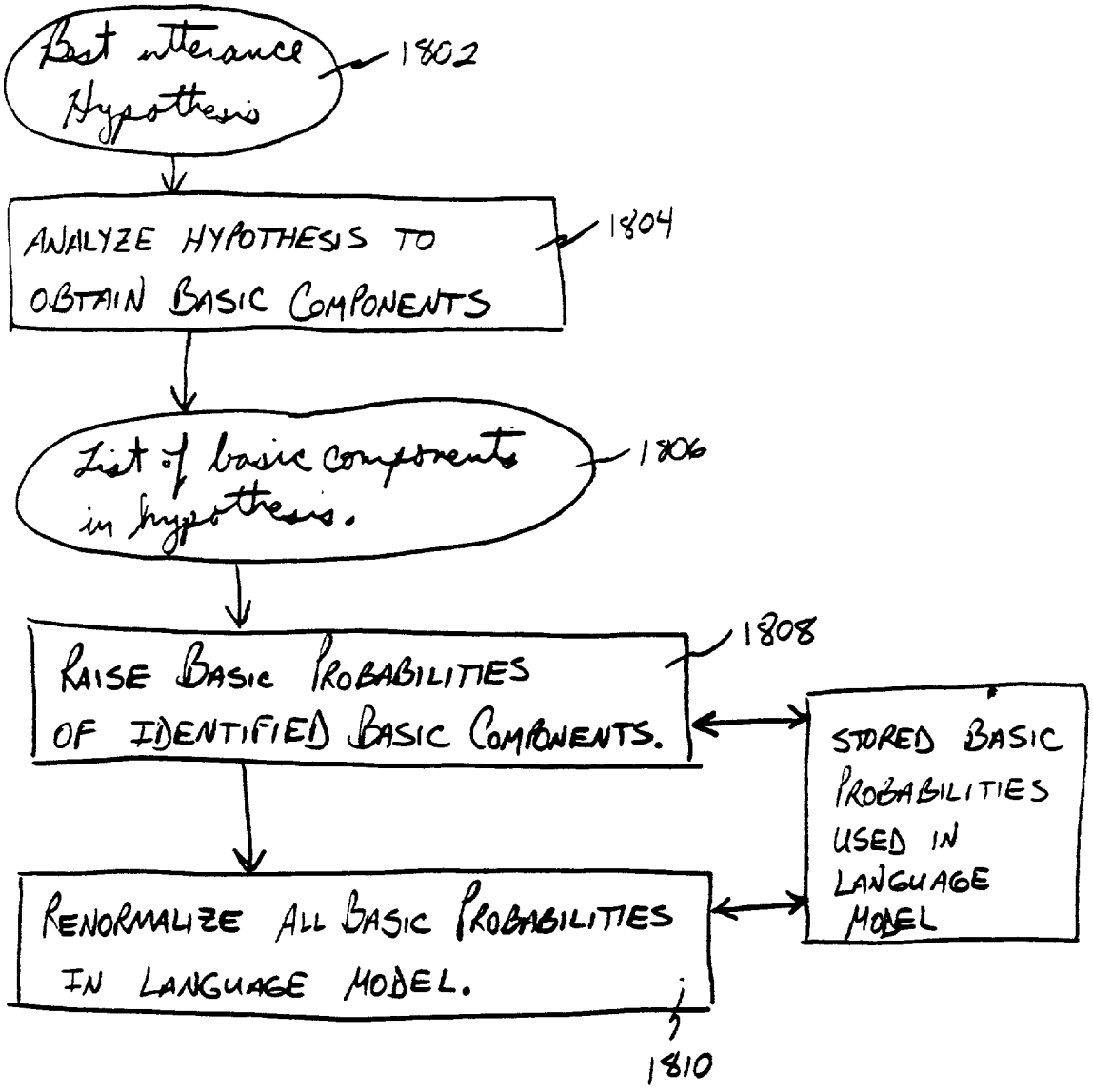

Best utterance Hypothesis
1802
ANALYZE HYPOTHESIS TO OBTAIN BASIC COMPONENTS
1804
List of basic components in hypothesis.
1806
RAISE BASIC PROBABILITIES OF IDENTIFIED BASIC COMPONENTS.
1808
STORED BASIC PROBABILITIES USED IN LANGUAGE MODEL
RENORMALIZE ALL BASIC PROBABILITIES IN LANGUAGE MODEL.
1810

FIGURE 18

FIGURE 19

0980850-0801802

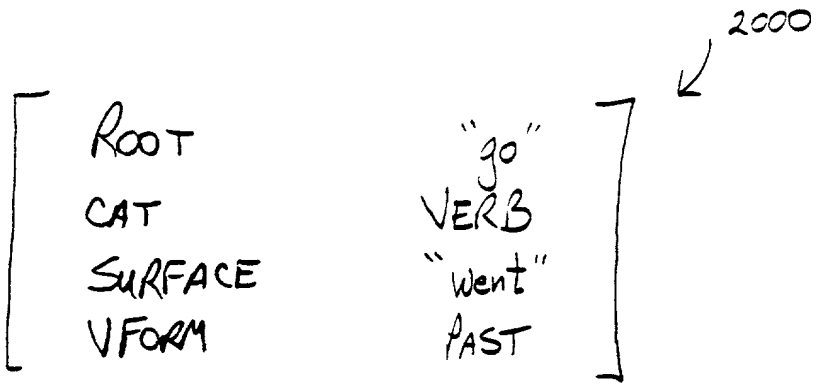



FIGURE 20

5888888-080804

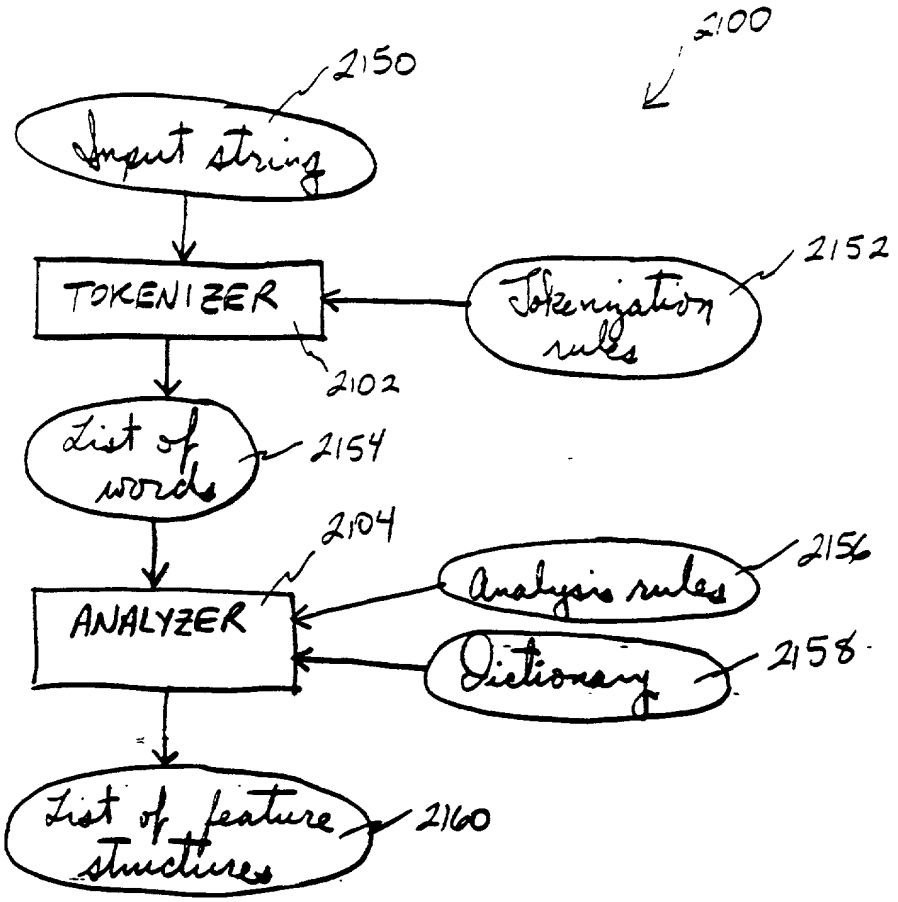

2100
2150
Input string
TOKENIZER
2102
Tokenization rules
2152
List of words
2154
2104
ANALYZER
Analysis rules
2156
Dictionary
2158
List of feature structures
2160

FIGURE 21

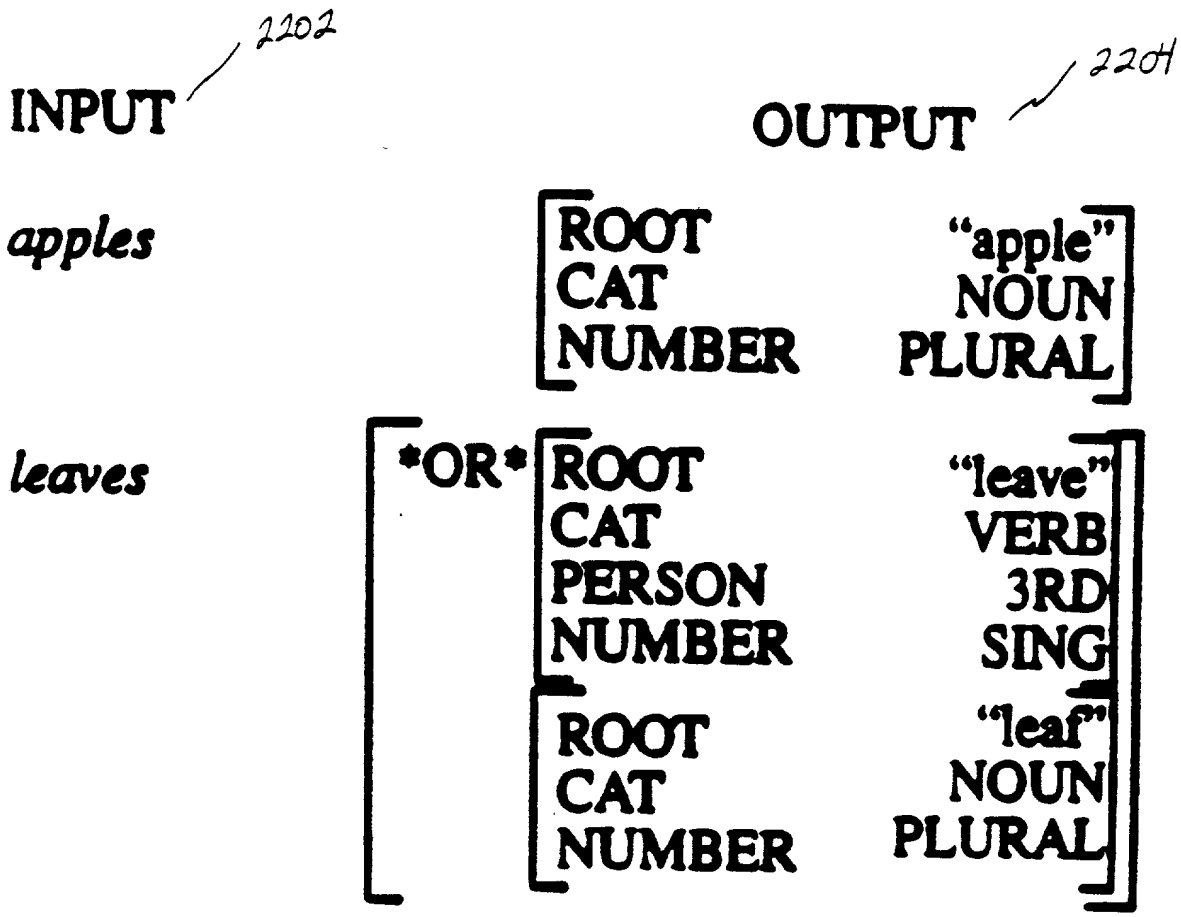

2202
2204
INPUT
OUTPUT
apples
ROOT "apple"
CAT NOUN
NUMBER PLURAL
leaves
*OR*
ROOT "leave"
CAT VERB
PERSON 3RD
NUMBER SING
ROOT "leaf"
CAT NOUN
NUMBER PLURAL

FIGURE 22

2302

| Inflection Type | Feature to trigger Generator or for Analyzer to create |
|---|---|
| past-tense form of verbs | (VFORM PAST) |
| past participle form of verbs | (VFORM PAST-PART) |
| present participle form of verbs | (VFORM PRES-PART) |
| present-tense form of verbs | (VFORM PRES) |
| present-tense 1st-person singular form of verbs | (VFORM PRES)(PERSON 1)(NUM SING) |
| present-tense 3rd-person singular form of verbs | (VFORM PRES) (PERSON 3)(NUM SING) |
| past-tense 1st-person singular form of verbs | (VFORM PAST)(PERSON 1)(NUM SING) |
| past-tense 3rd-person singular form of verbs | (VFORM PAST)(PERSON 3)(NUM SING) |
| comparative form of adjectives/adverbs | (AFORM COMP) |
| superlative form of adjectives/adverbs | (AFORM SUPER) |
| adverbial form of adjectives | (ADVERBIAL +) |
| plural form of nouns | (NUM PLURAL) |
| genitive form of nouns | (CASE GEN) |

FIGURE 23

2402

| Feature-Value Pair | Inflection Rules Applicable | Examples | Notes |
|---|---|---|---|
| CONS-DBL + | present-participle (VERB), past-tense (VERB), past participle (VERB), comparative (ADJ/ADV), superlative (ADJ/ADV) | "running", "submitted", "bigger" | Double final consonant and apply appropriate default rule. If the final consonant is "k", change it into "ck" instead of "kk". |
| Y-TO-I + | past-tense (VERB), past-participle (VERB), present-tense 3rd-person singular (VERB), plural (NOUN), comparative (ADJ/ADV), superlative (ADJ/ADV) | "studied", "studies", "candies", "tidier", "tidiest" | Change the final "y" to "i" and apply appropriate default rule. |
| F-TO-V + | plural (NOUN) | "leaves", "thieves" | Change the final "f" to "v" and apply appropriate default rule. |
| FE-TO-VE + | plural (NOUN) | "knives", "wives" | Change the final "fe" to "ve" and apply appropriate default rule. |
| AD-INFL + | comparative (ADJ/ADV), superlative (ADJ/ADV) | "faster", "fastest" | Generate inflected forms only if this feature exists. Otherwise, use "more"/"most" instead. |
| NO-COMP-SUPER + | comparative (ADJ/ADV), superlative (ADJ/ADV) | "right", "wrong" | Do not form a comparative or superlative if this feature exists. |
| ADJ-TO-ADV + | adverbial (ADJ) | "kindly", "greatly" | Generate adverbial form only if this feature exists. |
| ZERO-PLURAL + | plural (NOUN) | "love" | Do not form a plural if this feature exists |
| ZERO-SING + | plural (NOUN) | "trousers" | Always treat the word as plural. Do not use a singular determiner, etc. |

FIGURE 24

TOE780 "05898860

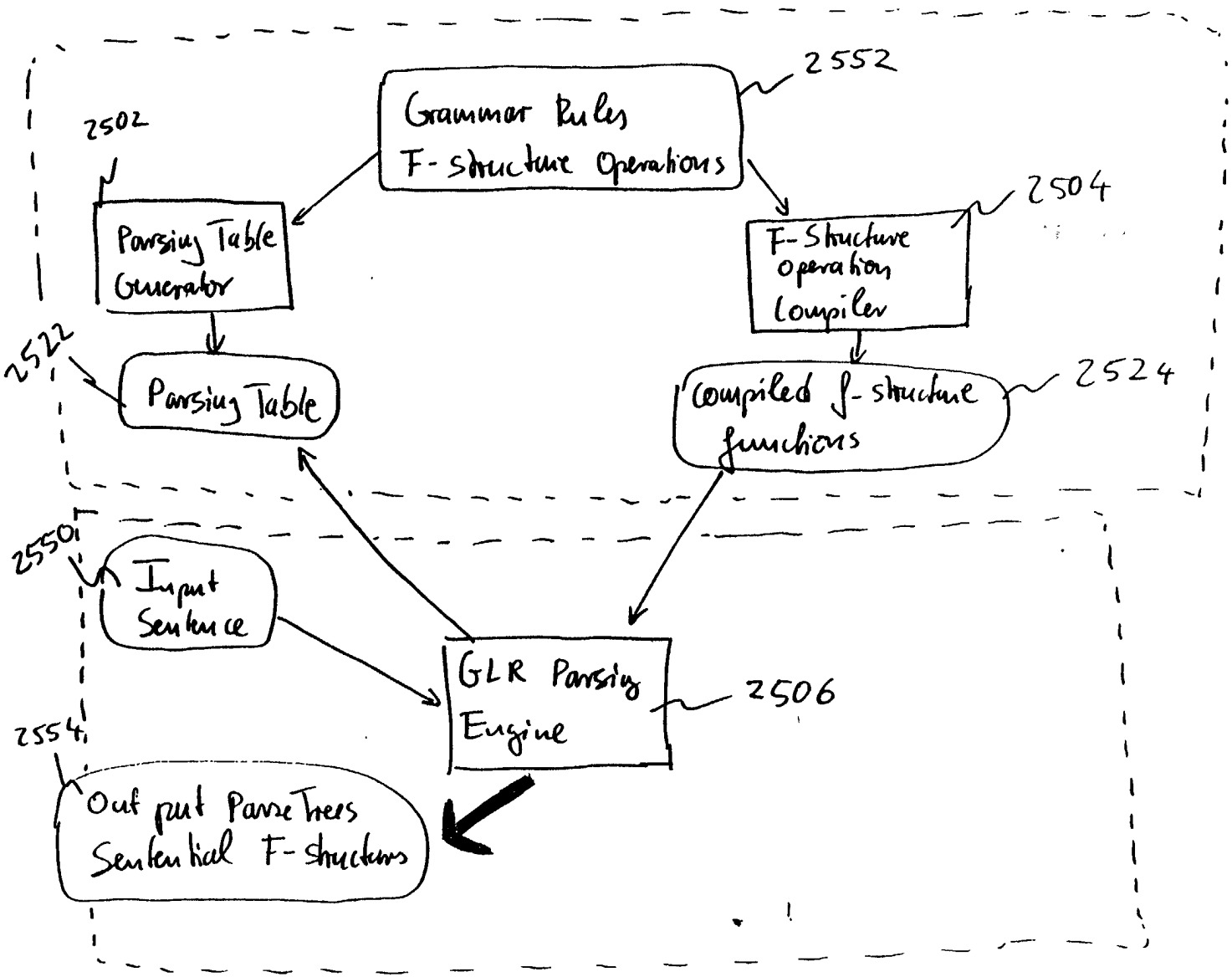



Figure 25

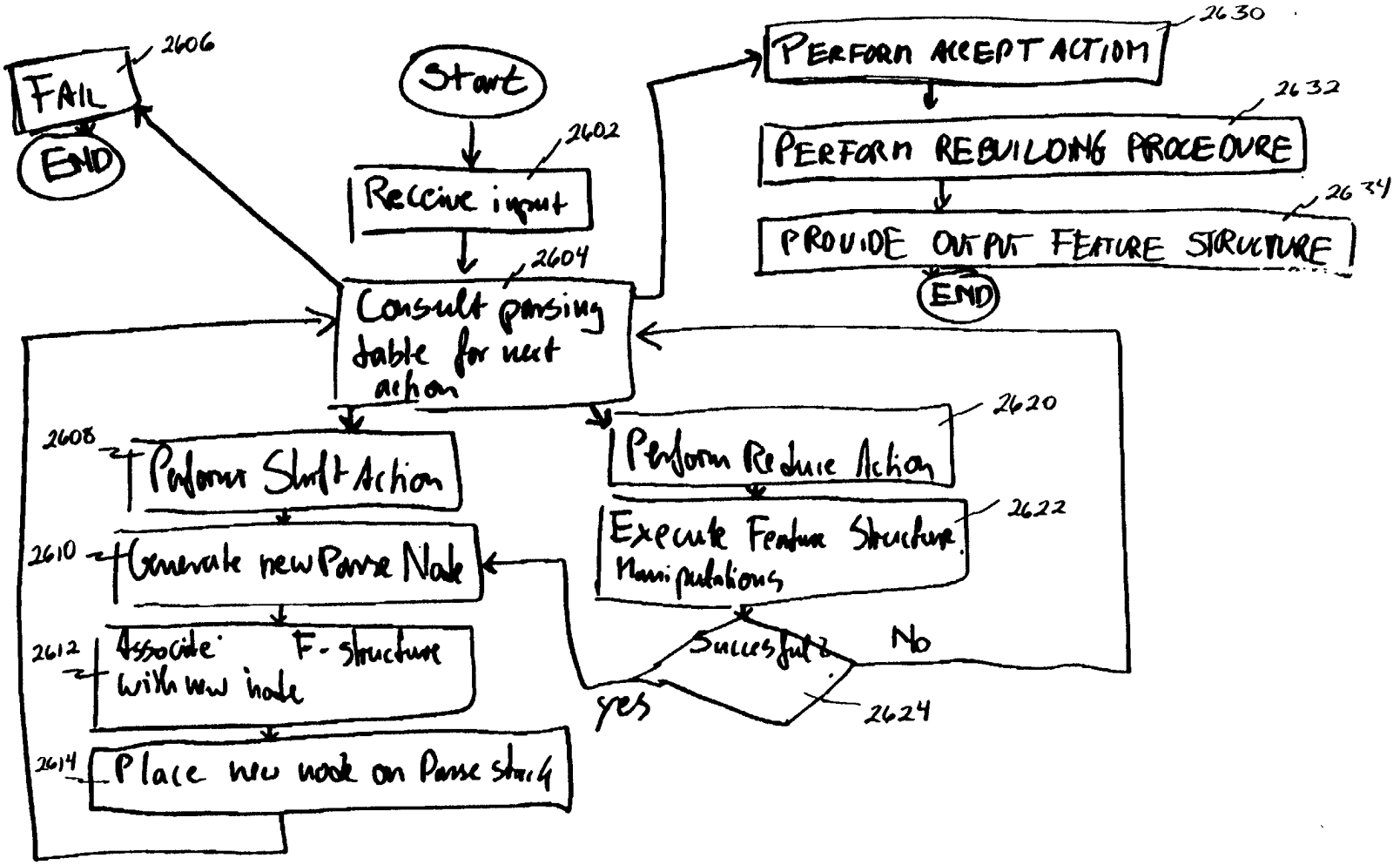

Start
2602
Receive input
2604
Consult parsing table for next action
2606
FAIL
END
2608
Perform Shift Action
2610
Generate new Parse Node
2612
Associate F-structure with new node
2614
Place new node on Parse stack
2620
Perform Reduce Action
2622
Execute Feature Structure Manipulations
Successful?
No
yes
2624
2630
PERFORM ACCEPT ACTION
2632
PERFORM REBUILDING PROCEDURE
2634
PROVIDE OUTPUT FEATURE STRUCTURE
END

FIGURE 26

TOETBO" 05898860

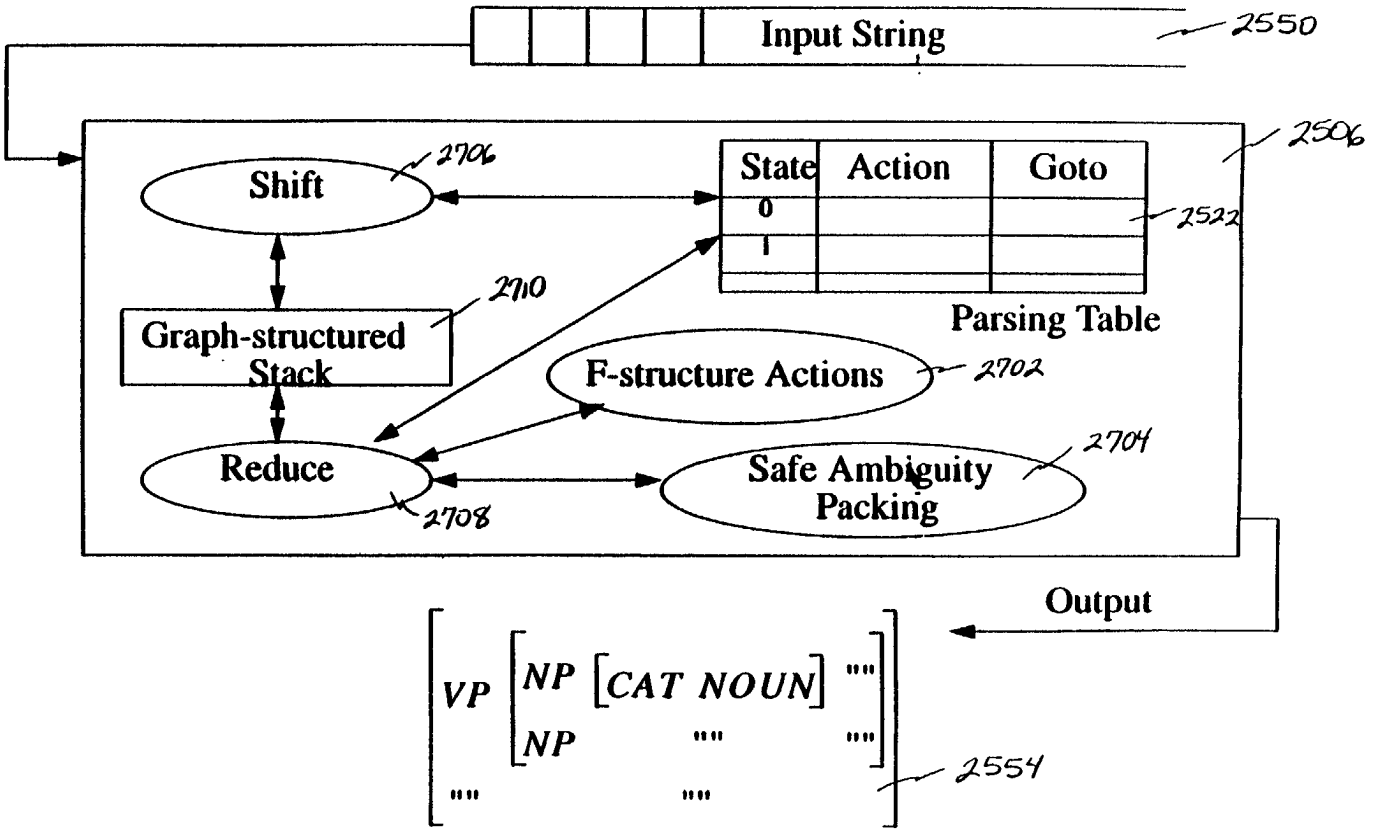



FIGURE 27